A Pre-Synopsis entitled

"Implication of Molecular Biotechnology in Production of Exopolysaccharides through Probiotics, Biofertilizers and Evaluation of Micro-organisms in Food Outbreaks."

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Introduction:

Probiotics are live microorganisms that confer a health-beneficial impact on the host by helping them restore beneficial gut microbiota when they take them in an adequate amount. Some of these can also be used for industrial purposes for the bio-removal of pollutants, including toxins and heavy metal residues in water and foodstuffs. The balance of the gut microbial flora greatly influences the intestinal environment and is an important component of maintaining intestinal homeostasis. Probiotics have a wide range of therapeutic benefits, due to which the expansion of research and the market value of probiotics have increased in the past few years. Probiotics have been therapeutically used to modulate immunity, lower serum cholesterol, and treat many other diseases.

The synthesis of exopolysaccharides (EPSs) by lactic acid bacteria is widely recognised, and in recent times, Lactobacillus-produced EPS has gained significant recognition due to its distinct chemical and physical applications in the food and pharmaceutical sectors. Probiotic-produced EPSs are significant because they may be used as emulsifiers, thickeners, medication delivery vehicles, and heavy metal removers. Compared to their non-producing counterparts, EPS-producing LABs are better able to endure technological stressors and make it through the digestive tract. Additionally, EPS may cause favourable physiological reactions such as decreased cholesterol, a decrease in the development of pathogenic biofilms, a modification of adherence to epithelial cells, and a rise in the quantity of bifidobacteria with prebiotic potential. Therefore, selecting starting cultures that produce EPS instead of nonproducing ones appears to have several benefits.

As part of the Atamanirbhar Bharat initiative, improving microbial strains to increase their production of metabolites for industrial fermentation is a major research focus aimed at helping India become self-sufficient. Strain improvement procedures are the science and technology used to manipulate bacterial strains. The production of chemicals to suppress contaminating microorganisms, lower fermentation costs, increased output, and the possibility to employ less expensive substrates are just a few of the many advantages of enhanced strains.

Foodborne illness is often confused with food poisoning, but it is better to refer to illnesses caused by chemicals or toxins in food rather than those caused by living pathogens. The World Health Organisation (WHO) defined "foodborne diseases" as "any disease of an infectious or toxic nature caused by or thought to be caused by the consumption of food or water." An infection or foodborne disease is any gastrointestinal illness caused by ingestion of contaminated food altered by a pathogenic entity, such as bacteria, fungi, viruses, moulds, protozoa, or parasites. Biological hazards are far more frequent, yet it is still vital to evaluate the physical and chemical alterations in food, whether intentional or unintentional. Microorganisms or their byproducts are known as biohazards because they can cause infections, intoxications, poisonings, or allergies that can be harmful to human health. According to data analysis, the highest average outbreaks were recorded by the states of West Bengal (31.22), Karnataka (29.11), and Gujarat (22.67), which also contributed to 31.5% of illnesses and 8.7% of deaths. Grain and bean consumption was shown to be a food vehicle responsible for the highest outbreaks (32.7%) among 19.6% of outbreaks, whereas food tainted with chemicals was

responsible for maximum mortality (70%). ARIMA models performed poorly because there were little relationships between climatic conditions and outbreaks.

Food safety accidents in the red meat business continue to be a major global problem, posing a serious risk to public health. These may take the form of food contamination, which mostly happens in the processing, distribution, retail, or catering industries (FSA, 2020). These episodes may then spark an epidemic of foodborne disease or outbreaks, depending on where the contamination occurs. Approximately half of the European listeriosis outbreaks that have been documented have been linked to dairy products. The use of raw milk or items derived from unpasteurized milk has been primarily associated with outbreaks of listeriosis.

Fertiliser minerals are a global commodity that is essential to the profitable cultivation of sustainable crops. An adequate supply of it enhances the properties of soil and is important for plant development, soil fertility, food security, environmental development, and sustainable agriculture. It is essential to strengthen the economy of the country since agriculture is the main industry. By 2025, it will guarantee the world's food supply for over 8 billion people. To fill the gap between the nutrient supply from the soil and organic sources and the nutrient requirement for optimal crop development, it must be available in adequate amounts and the right proportion. The fertilisers notably phosphorus (P) and nitrogen (N) are janus-faced; positive fertiliser, negative environmental concerns. Negative environmental concerns are the result of inefficient and non-demand-oriented use. In particular, abuse of N and P will cause eutrophication in waterways, and N may cause groundwater leaching issues in addition to air pollution from nitrous oxide emissions, which worsen the warming impact. Therefore, crop yield and efficiency are directly impacted by effective fertiliser management. However the current wave of climate change is presenting an unparalleled challenge to the agricultural sector, and therefore to the fertiliser business.

The genetics and biotech industries have assured us they can deliver increased yields, promising leaps in genetic yield potential of 3 to 4% per year. The report's authors identify better rain-fed agriculture and irrigation management, genetic engineering for high-yielding crops, precision agriculture, drought-tolerant crops, and several other factors required for new agricultural approaches as critical long-term strategies to feed the world. However, they say little about the role of fertiliser. As we work on this issue, we intend to discuss the significance of fertilisers, which may help to both increase crop productivity and restore soil fertility, providing the world with the essential shift to feed its growing population.

Objective of research:

Given the significance of the subject, the current inquiry will be conducted with the following goals in mind:

- Gathering samples of various probiotic strains and enhancing them.
- Research the usage of exopolysaccharides released by LABs in probiotics.
- Research into the bacterial and fungal infections that cause food to rot.
- Study of illnesses on diverse crops and designing a biofertilizer for their removal.

Review of literature and development in the subject (Previous work done in the relevant area):

Yoghurt starter cultures generate EPS, which has an impact on the texture of yoghurt and enhances its mouthfeel, shine, clean cut, ropiness, and creaminess. Yet, the ultimate textural qualities of yoghurt are heavily influenced by the structural attributes of the EPS, including kind, degree of ropiness, sugar content, and branching degree. The process of fermenting milk results in the slow generation of EPS. Therefore, the amount of it in the finished product, its molecular makeup, and how it interacts with proteins change depending on how long the fermentation process takes. The influence of EPS and other processing parameters on the rheological characteristics of yoghurt appears to vary widely, despite a large number of studies being done in this field. This might indicate that the EPS–protein interactions that alter the texture are complicated in nature.

Four distinct carbon sources were present in the ABT5 starting culture's EPS at varying concentration levels when the culture was analysed. They underwent protein and exopolysaccharide precipitation processes; the EPS that resulted from these processes was examined for amount, monomer composition, and potential effects on the final product's viscosity. While EPS was quantified colourimetrically, gas chromatography was used to separate the monomers and analyse their composition. Numerous parameters, including the organism's development, the incubation temperature, strain fluctuation, and the composition of the medium, are known to affect the quantity of extracellular polymer synthases (EPS) generated by starting cultures.

The foodborne illnesses that are infectious and intoxicating, caused by Salmonella spp. and Staphylococcus aureus, are the subject of the food poisoning cases that were looked at in Hyderabad between 2003 and 2005. It's noteworthy to note that Staphylococcus aureus is the culprit in the majority of food poisoning cases that have been studied. Appropriate preventative and educational actions should be implemented to stop outbreaks of food poisoning. The foodborne disease surveillance system should be significantly strengthened by the health authorities, who should also effectively implement education and extension programmes and address other issues of food safety. The integration of epidemiological and laboratory components into monitoring programmes is necessary in our nation to accurately assess the true prevalence of foodborne illnesses at different levels of government (Sudershan, Naveen Kumar et al. (2014)).

Long-term field experiments have demonstrated the crucial role that fertiliser input plays in crop yield. Fertilizer's average share of output in temperate climes, like the USA and England, was often between 40 and 60 per cent. But in the tropical regions with more heavily worn soils (such as the Amazon Basin in Brazil and Peru), fertiliser input was far more important than output. Yields due to fertiliser and lime after the second year of land clearance were never less than 90%. It is fair to conclude, based on previous assessments, that in the absence of sufficient plant nutrition, the globe would produce around half as much basic food and would need to use more wooded areas for production. Although inorganic fertiliser is essential to the world's food security, it is important to acknowledge that some systems achieve maximum yields when both organic and inorganic nutrient sources are used. For plants to use nutrients more effectively and to produce as much food as possible, integrated soil fertility management is essential. The adaptable foundational concepts of nutrient management, known as the 4Rs — right source at the right rate, right time, and right location — may be applied to any cropping system to guarantee maximum production(Stewart and Roberts 2012).

Methods to be adopted:

- Collection of diverse probiotic, Plants (fruits and vegetables) samples.
- Setting up many dilution plates and tracking their development trajectory.
- To enhance the strain in the probiotic sample, we will be using a variety of techniques.
- We will initially monitor the exopolysaccharide secretion from the LAB sample and devise strategies to boost its development.
- Food samples that have gone bad or are about to go bad will be gathered from various locations, and the organisms causing these rots will be investigated.
- A soil sample from various agricultural lands containing a variety of fruits and vegetables will be gathered. Subsequently, the strains of the bacteria and fungi that may be employed as biofertilizers will be improved by identification.

Importance of Study/ society application:

The probiotic strain must endure in the location where it is thought to be active. The strain has to be able to multiply and colonise at this particular site to function at its best. Besides, the immune system ought to be able to withstand it. It must not be mutagenic/carcinogenic, allergenic, or pathogenic. Human probiotics need to be "generally regarded as safe," meaning they have shown little potential to cause illness or be linked to its aetiology. Preferably human-derived, the probiotic organisms must be able to endure low pH and high concentrations of conjugated and deconjugated bile acids to grow and live in the in vivo circumstances of the intended site of administration. In order for probiotics to be successfully incorporated into food products, they must also be technologically compatible with the food manufacturing process. Furthermore, the meals containing the probiotic bacteria need to preserve the unique sensory qualities of the original dish. The native microbial communities are known to be host-specific, location-specific, highly complex in composition, and to have advantageous qualities for the host. The specific species of microbes responsible for these advantageous characteristics are unknown, though.

The need for probiotic foods has surged as a result of rising scientific data supporting the health advantages of probiotics and expanding public awareness of diet-related health problems. Probiotics have been proposed to be delivered to consumers through a variety of food products, such as yoghurt, frozen fermented dairy desserts, cheeses, ice cream, spray-dried milk powder, and fruit juices. It has been proposed that in order to provide health benefits, 109CFU of probiotic bacteria should be consumed daily. Overall, choosing a compatible probiotic strain and food type combination, using food processing conditions that support probiotic survival, making sure the food matrix supports probiotic growth (if fermentation is necessary), choosing a product matrix, packaging, and environmental conditions to ensure adequate probiotic survival over the product's supply chain and during shelf storage, and finally making sure the addition of the probiotic does not negatively impact the product's taste and texture are the main considerations when incorporating probiotics into food.

The food sector is particularly interested in learning more about lactic acid bacteria's (LAB) ability to produce exopolysaccharides, or EPS. EPS can be viewed as natural biothickeners as they are created in situ by LAB and improve the rheological characteristics of fermented meals. Furthermore, EPS generated by LAB has been shown in several studies to have positive impacts on gut microbiota modulation and health promotion. The composition and structure of the EPS vary greatly, and it may

have a variety of physiological impacts, including cholesterol reduction, glycemic management, antioxidant, immunomodulatory, and calcium and magnesium absorption. Detailed descriptions of the most recent developments in the physicochemical characteristics, biosynthesis, and structure of EPS obtained from LAB are given. A description of current techniques for identifying, describing, and clarifying the structure of EPS generated by LAB follows here. Furthermore, strategies for using EPS produced by LAB in food products have been discussed. These strategies have focused on beneficial applications in dairy products, low-fat meat products, and gluten-free bakery products, as they have a positive impact on the final product's consistency, stability, and quality. Reports of health-promoting benefits are also highlighted, with special attention paid to drug-delivery, immunomodulatory, antioxidant, cholesterol-lowering, anti-biofilm, antibacterial, and anticancer properties.

A food-borne outbreak is commonly described as a situation when two or more people become unwell after consuming the same dish or meal. A patient in a sporadic instance has not been aware of exposure to another individual who is similarly unwell. Although sporadic instances are significantly more frequent than outbreaks, they are more difficult to identify and analyse. As a result, the majority of nations simply look into and report food-borne illness outbreaks. Investigations into epidemics aid in controlling current outbreaks and preventing new infections. They are essential in avoiding foodborne illnesses as well. Investigations may uncover previously undiscovered weaknesses in the food safety system as well as novel diseases and food vehicles. They can enhance our understanding of the scientific process by which the contamination happened at particular points in the food supply chain, how likely it is to happen again, and how to lessen or eliminate it.

Investigations into outbreaks frequently bring up issues that inspire further studies to learn more about how contamination happens and how to lessen or avoid it.
Investigating outbreaks provides a chance for many agencies and experts to collaborate as a team. They could highlight areas for improvement in the public health systems that identify and contain epidemics.

The amount of foodborne diseases that occur should go down as a consequence of better industry practices, legislation, and enforcement by regulatory authorities, as well as improved consumer understanding and research outcomes from outbreak investigations.

Biofertilizers are ways of stabilising the nutrient availability in the soil. In general insufficiencies in nitrogen.
A bio-fertilizer may form a symbiotic relationship with plant roots since, in a sense, it is living. Complex organic materials might be quickly and safely converted into simpler molecules by the involved microbes, allowing the plants to absorb them more readily. The long-lasting action of microorganisms increases soil fertility. It preserves the soil's natural environment. It substitutes chemical nitrogen and phosphate by thirty percent, boosts plant development, and raises agricultural output by twenty to thirty percent. Additionally, it can offer defence against certain soil-borne illnesses and dryness.

Additionally, research has demonstrated that biofertilizers with the capacity to fix nitrogen and solubilize phosphorus would have the highest possible impact on crop yield. Compared to control groups, they promote the development of many crops' shoots and roots. This may be crucial for introducing fresh seed development. Additionally, biofertilizers support healthy soil, which increases farming sustainability.

Suggested research organisation, concept, and work plan:

Work schedule with annual goals to be met.

Year I: Literature search, course work and standardisation of experimental techniques.

Year II: Gathering samples, examining their growth patterns, creating improved strains, and using them in therapeutic settings.

Year III: Publishing research papers and writing thesis.

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